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ABSTRACT

Research on the interaction of keyword treatment with materials or student characteristics in learning foreign languages was reviewed. Most of the studies implied that foreign language vocabulary learning was related to verbal, not visual-spatial ability or elaboration, conditions, and that student-generated keywords were more effective than instructor-generated keywords. There were four suggestions for future research: (1) develop an instrument for predicting performance in visual elaboration conditions not involving picture production; (2) use pretests to explore possible aptitude treatment interaction and to reduce within-cell variability; (3) determine if cognitive ability can be modified to improve performance; and (4) determine if keyword instruction benefits or hinders specific foreign languages. (CP)

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Individual Differences and Materials Differences which may Affect Keyword Method Utility

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It is my bias to expect that there are some materials and some individuals for which the keyword method will work less well than for others. From one perspective, that seems to be nothing more than a truism. However, it is obviously important for practical reasons to know for what specific situations and learners the keyword method is best suited. Such knowledge is just as important to the theoretician as the practitioner. For example, one way of deciding if a process is critical to keyword performance is to examine situations where that process is hampered and see if keyword performance is similarly impaired.

Unfortunately, there has been very little keyword research up to now that has systematically explored possible interactions of keyword treatments with materials or learner characteristics. There are however a few studies in related areas which suggest when such interactions might be expected.

In my remarks, I will be reviewing the results of a number of these studies, attempting to draw implications for keyword research. Then I will conclude by commenting briefly on some promising directions for future research in the area.

Let me begin with individual differences in relevant cognitive abilities. Since the keyword method is typically thought of as an imagery technique, one might expect that some kind of imagery ability would be quite important for performance in that task. The study of individual

differences has been proceeding since Galton (1880) assessed subjects' imagery by asking them to rate the lucidity of their images with his Breakfast Table Questionnaire. Unfortunately, self-ratings of vividness of imagery typically do not predict performance in the learning of verbal materials (e.g., Turner, 1978). Objective tests of imagery ability (of the kind referred to as spatial ability by factor analysts) thus came into use, with tests which required visualizing mental transformations of geometric forms typically being employed. Such tests were used as predictors in a paired-associate learning study in a 1965 disseration by Stewart (Note 1). Stewart compared high and low "imagers" on the learning of pictorial and verbal stimuli, with the imagery groups being matched on IQ and GPA. An interaction was found such that high imagers learned picture materials more rapidly than low imagers, but low imagers learned verbal stimuli more rapidly than high imagers. (Certain of the details of this result and others reported herein appear in Appendix A.) Stewart interpreted her results as if high imagery ability and high verbal ability were opposite ends of a single bi-polar dimension, which is not the case. However the interaction of spatial ability with the learning of different materials has proven replicable.

A related finding is the interaction involving imagery ability obtained by DiVesta and Sunshine (1974). Again pictorial materials were involved for some subjects but they

were the ones created by the subjects in the visual elaboration condition, rather than being ones supplied by an experimenter. A previously learned jingle (e.g. "one is a bun...") provided either concrete or abstract stimulus words which subjects were required to link to concrete and abstract response words by overt production of either visual or verbal mediators. An interaction of imagery ability with mnemonic instructions was obtained having similarities to that observed by Stewart (Note 1). The gain resulting from having a subject draw a picture of an interactive image of the referents of the stimulus and response words was directly and strongly related to the subject's spatial ability (see Appendix A, page 1).

If we stopped here to draw implications for keyword applications we might conclude that the typical keyword condition would interact with spatial ability. And, we might also conclude that verbal ability is unimportant or is inversely related to keyword performance. Both of these tentative conclusions have been demonstrated to be incorrect by subsequent research.

It has seemed to me that, even with keyword instructions, foreign language vocabulary learning is still essentially a verbal task. Thus in my research on the keyword I have examined both visualization and verbal abilities, taking an aptitude-by-treatment interaction (ATI) approach of attempting to optimize learning through capitalizing on an individual's strengths (e.g. Cronbach &

Snow, 1977; Levin, 1977). Thus I expected that subjects who are strong in a particular ability should perform beeter when required to use a learning strategy that depends on that ability. In a study designed to test this hypothesis (Delaney, 1978), Malay words were chosen as the foreign language stimulus terms because of their phonetic similarity to English. Undergraduate students were assigned randomly to one of three groups. The visual and verbal elaboration conditions were keyword groups, with subjects generating keywords in these conditions. The third group was a control condition in which subjects were not restricted to any particular learning strategy. The improvement of subjects in the generated-keyword conditions in total correct responses over four trials was approximately 30%. The lack of a spatial ability X elaboration condition interaction suggested that visualization/spatial ability is apparently not the principal ability required to utilize a visual elaboration strategy (see Appendix A, page 2). Other data consistent with this conclusion were recently reported by Turner (1978, Experiment 2), who found that scores on the Minnesota Paper Form Board test of spatial ability were unrelated to performance in noun pair learning under imagery instructions (see also Paivio & Yuille, 1967).

The finding of most interest however in Delaney (1978) was the interaction between verbal fluency ability and elaboration condition. It had been predicted that the regression of performance on verbal fluency would be steeper

in the verbal elaboration condition than in the visual elaboration condition. And, as predicted, verbal fluency ability was strongly related to performance in the verbal elaboration form of the keyword method but was weakly (and in fact) inversely related to performance in the visual elaboration form of the keyword method. Put differently, for high verbal ability subjects, the verbal form, which was particularly suited to their abilities, resulted in greater facilitation than the visual form. But for low verbals, instruction in the verbal elaboration strategy was absolutely no help; their performance was no different than the control condition (see Appendix A, page 2).

This suggests that to answer the question "What form of the keyword method is most effective for a young adult?" one would need to know the verbal fluency ability of that individual. This result also has theoretical implications. It suggests that the underlying processes by which the keyword method facilitates performance depends on both the particular form of the method that subjects are instructed to use and the particular pattern of abilities the individual possesses. The results are consistent with the notion that in the verbal form of the method the subject in fact proceeds by generating a number of verbal responses and selecting ones meeting certain lexical or semantic constraints--since these are essentially the processes required by tests of verbal fluency. The processes required by the visual elaboration condition are less clear, though

certain plausible hypotheses are eliminated by the next set of results.

The factor of elaboration conditions, like visualization/spatial ability, does not interact with materials differences in the concreteness of the verbal items being learned. Commenting first on visualization/spatial ability, although one might have expected that "imagers" high in this ability would be especially adept at learning concrete verbal items, such is not the case (Delaney, 1978; see also Stewart, 1965, Experiment 3). Of more interest in our present context, elaboration condition also does not interact with concreteness of verbal items (see Appendix A, page 3). This finding has been demonstrated by Delaney (1978) using foreign language words as stimuli, by Paivio and Yuille (1967) using English words, and is consistent with the results reported by Miller (Miller, Levin & Pressley, Note 2). Montague and Carter (1973) on the other hand found that vividness of the descriptions used in a prose passage did interact with instructions to use imagery, where the dependent variable was amount of information recalled from the prose passage. However, for types of words used thus far in keyword studies in the literature, whether or not the method has worked has not hinged on the item characteristics. It is interesting to note that the visual elaboration instructions do not result in subjects generating visual images for abstract items, even though

they have high recall scores for such items. Subjects in the visual elaboration condition simply do not follow instructions then. That is, their self-reports are just like those instructed to use verbal elaboration in that they indicate generating verbal links for about half the abstract items (Delaney, 1978). Thus I believe it can be concluded that benefitting from the visual elaboration form of the keyword condition does not hinge on a subject's formulating a visual image for each item pair.

Let me turn now to a discussion of an apparent interaction involving some yet-to-be-specified population characteristics; namely, the effectiveness of certain keyword conditions seems to depend on apparently minor population and/or treatment differences. Consider the question of whether it is more effective to have subjects generate the keyword or have the experimenter provide the keyword. There have been almost no published data relevant to the question. Although Raugh and Atkinson (1975, p. 15) refer to certain pilot data as a basis for recommending that experimenter-supplied keywords be used, Fuentes (Note 3) in his 1976 dissertation at Stanford revealed that in fact only 3/4 of the data collected in that pilot study were examined, and that, for the portion examined, there was no statistically significant difference. In his classroom study Fuentes replicated this "no-difference" result. However, in addition to whatever transfer of information about strategies might have taken place among students in

various conditions over the six weeks of Fuentes' project, the interpretation of the lack of a difference between the keyword groups is furthered weakened by the training procedures employed. Both the keyword-provided and keyword-generated subjects in a particular class received their training in the same one-hour session. Both groups were given practice generating keywords and had to meet the same criterion of learning five foreign language word meanings by generating keywords and an interactive image for each in order to end their training. The data of Hall, Wilson, and Patterson (Note 4), showing an advantage of experimenter-supplied keywords, are in contrast to this null result.

However, I now have in hand data from 3 studies each of which supports a conclusion opposite to Hall's, i.e. they support the effectiveness of the keyword-generated condition. Despite the fact that Atkinson implied otherwise, I had expected the self-generated keywords would be more useful in learning than supplied keywords. This was because of the finding in verbal learning that self-generated mediators are more useful than experimenter-supplied mediators (e.g., Bobrow & Bower, 1969). The first keyword study suggesting this is Delaney (1978): visual and verbal elaboration instructions, in conjunction with instructions to generate keywords, both resulted in significantly better performance than controls (see Appendix A, page 3). The other two studies have just

been completed, in collaboration with Marsha Starr. Independently of Hall et al., I also decided to compare keyword-generated and keyword-provided conditions in a group-administered setting where subjects were free to allocate the total study time to whatever items on the list they chose. The only substantial difference in procedure between our two studies seems to be that Hall, like Fuentes, required subjects in the keyword-generated condition to actually write down their keywords. Also, in my study four minutes were allowed for study of a 25-item list of Russian-English word pairs; this allotment of roughly 10 sec per pair was about half of the study time resulting from Hall's use of 10 minutes for 30 Spanish-English items. Keywords for the keyword-provided condition were taken from the Atkinson and Raugh (1974) Tech. Report in which the procedure proved half-again as effective as an "unconstrained control group" (1974, p.1). In our head-on comparison of a keyword-provided condition with a keyword-generated condition, the keyword-generated condition proved significantly more effective than the keyword-provided condition.

Once again I found an item-by-item post-test questionnaire to be very useful in trying to understand why I obtained these results. On this post-test questionnaire, subjects in the keyword-generated group reported that they were able to establish a mediating link less often than the keyword supplied group (mean percentages of pairs "linked"

were 42.4% and 48.7%, respectively). However, among those items for which an individual reported establishing an association, a much higher proportion was recalled by the keyword-generated subjects (80.3% correct vs. 54.5% correct respectively). Thus, although mediators were apparently formed less frequently by the keyword-generated subjects, these links seemed to be much more effective when they were formed than links based upon experimenter-provived keywords.

Incidentally, there was practically no evidence to suggest an interaction of the provision-of-keyword factor and item characteristics whereby the keyword-provided condition might be more effective for some items. Recall of an English translation was higher for the keyword-provided condition than the keyword-generated condition for only 2 of the 25 word pairs.

A third study in this series was just completed and again demonstrated the effectiveness of the keyword-generated condition (see Appendix A, page 4). A major purpose of this study was to see if the overall advantage of the keyword-generated condition would be sufficiently robust to manifest itself in a situation where the Russian words were pronounced for the subjects and where the subjects were experienced foreign language learners. Another purpose of the study was to determine if the impact of having subjects generate their own keywords would be equivalent for both visual and verbal elaboration conditions. The overall difference between groups was

significant, $F(4, 74) = 3.791$, $p = .01$. Preplanned comparisons indicated that in fact the keyword-generated groups' level of performance was significantly higher than that of the keyword-provided groups, $F(1, 74) = 8.255$, $p = .005$. This difference however was due almost entirely to the facilitating effect of having subjects generate keywords for visual elaboration, with this difference being significantly larger than the small difference between the verbal elaboration groups, $F(1, 74) = 6.123$, $p = .016$.

Three pre-measures of subjects' abilities were used to reduce within-cell variability in these tests. The best predictor of performance was a pre-test of paired-associate learning ability taken from the Modern Language Aptitude Test (Carroll & Sapon, 1958), $F(1, 74) = 11.957$, $p = .001$. Verbal fluency ability also contributed substantially to the explained variance, $F(1, 74) = 9.590$, $p = .003$. In accord with the findings of Delaney (1978), there was no predictive value for the current task in a subject's visualization/spatial ablity, $F(1, 74) < 1$. However, in contrast to those previous results, verbal fluency here did not interact with the treatment contrasts of interest, i.e., within-cell regression lines were approximately parallel.

Let me conclude by briefly commenting on some directions for future keyword research that I believe need to be explored. First, I think that an instrument that predicts performance under visual elaboration but not verbal elaboration instructions is needed. My psychometric hunches

lead me to believe that if there is variability within the treatment (which there is) then a measure can likely be devised that will predict a reasonable portion of that variability. In addition, papers such as that by Carroll (1976) persuade me that it is conceivable that a careful analysis of the requirements of such a test could lead to an understanding of the cognitive processes contributing to the performance on both the test and the experimental task. I think this strategy has worked to some extent with verbal elaboration and hope that it will also prove effective with visual elaboration.

Secondly, foreign vocabulary learning pretests should be used in keyword method research. Not only will this yield the practical benefits (for investigators) of more powerful statistical tests but there are good theoretical reasons as well: (1) ATI's are quite useful for theorizing about processes and you have to have an aptitude measure in order to observe an ATI; (2) this will help other investigators to determine if there are population differences across studies.

Thirdly, there is only limited research on the modifiability of particular cognitive abilities. It is conceivable that one could alter certain of these abilities so that the individual would benefit to a greater extent from instruction in the keyword method. And it is also conceivable that extensive practice in using the keyword method might itself produce a lasting effect on some general

cognitive ability. If so, that would be important and interesting to know.

Finally, there is the question of the generality of the method across language and word types. Research on these questions has hardly begun. The dissertation by Fuentes included a variety of grammatical classes of items in his study but did not systematically examine their effects. The use of verbs in the study reported by Gloria Miller is a step in the right direction. I might also mention some pilot data I am collecting on possible interactions of keyword method effectiveness with foreign language type. There it looks like keyword instructions may facilitate performance with Romance and certain non-Romance langugaes, but may actually hinder performance with languages such as Navajo or Hebrew where it is harder to establish a keyword on the basis of acoustic similarity. Hopefully, these and other issues re keyword method effectiveness will be clarified in the coming months by research which focuses on the importance of the characteristics of the materials and learners in addition to a refinement of the components of the treatment itself.

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Appendix A

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INDIVIDUAL DIFFERENCES AND MATERIALS DIFFERENCES WHICH MAY AFFECT KEYWORD METHOD UTILITY

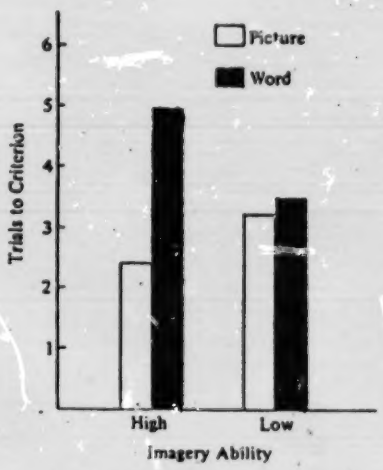
Relevant Evidence re Aptitude X Treatment and Materials X Treatment Interactions

1. Imagery (spatial) ability interacts with the materials factor of pictorial vs. non-pictorial stimuli to determine rate of learning lists of items.

Mean number of trials to criterion

		Materials	
		Pictures	Words
Imagery (Spatial) Ability	High (n=16)	2.44	5.00
	Low (n=16)	3.19	3.50

Data from Stewart (1965)

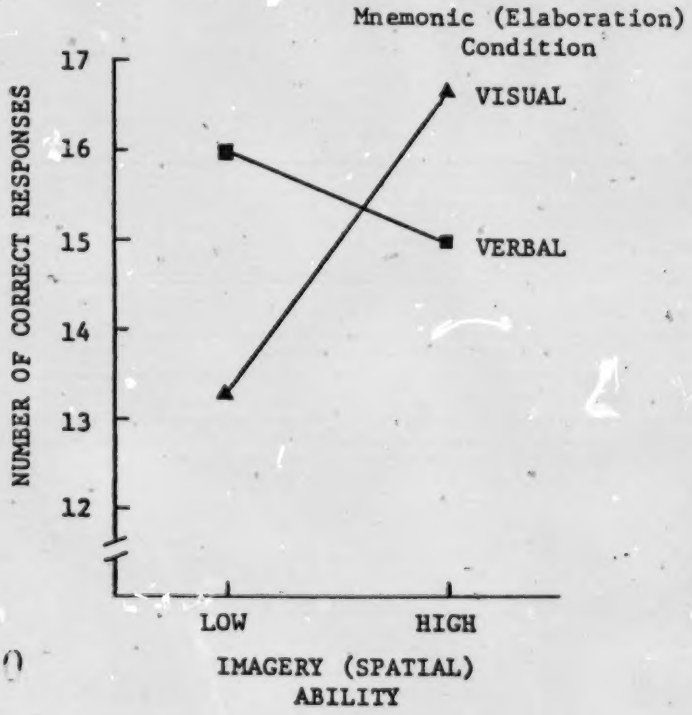


2. Imagery (spatial) ability interacts with elaboration instructions when the visual elaboration condition requires the production of pictures.

Mean number of correct responses

		Mnemonic (Elaboration) Condition	
		Visual	Verbal
Imagery (Spatial) Ability	High	16.69 (n=24)	14.97 (n=24)
	Low	13.31 (n=20)	15.97 (n=20)

Data from DiVesta and Sunshine (1974)

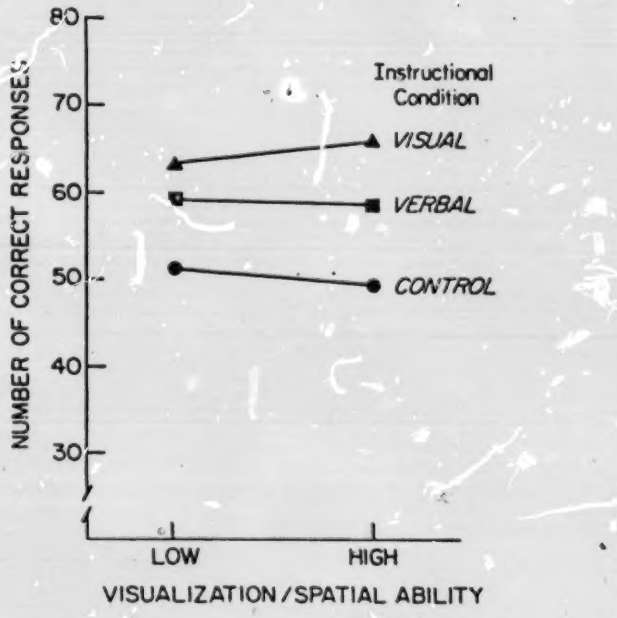


3. Visualization/spatial ability does not interact with elaboration instructions when the visual elaboration condition involves the covert production of images.

Mean number of correct responses

Visualization/Spatial Ability	Elaboration Condition: Visual	Verbal	Control
High	65.75 (n=8)	58.50 (n=8)	49.25 (n=8)
Low	63.64 (n=8)	59.00 (n=8)	51.13 (n=8)

Data from Delaney (1978)

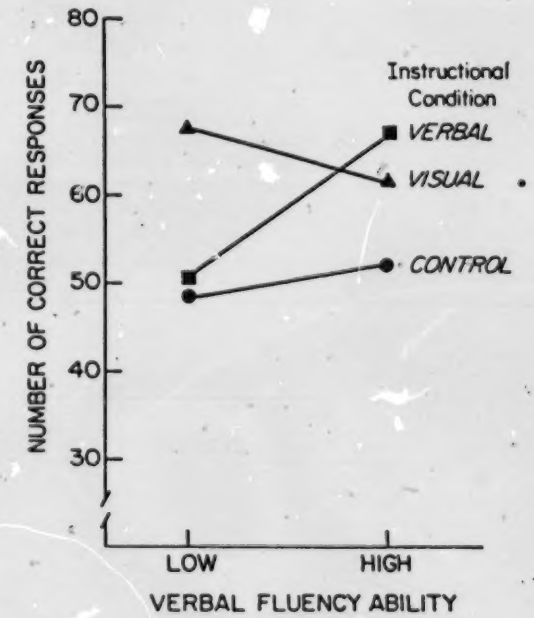


4. Verbal fluency interacts with elaboration conditions involving subject-generated keywords and mediators.

Mean number of correct responses

Verbal Fluency Ability	Elaboration Condition: Visual	Verbal	Control
High	61.75 (n=8)	67.00 (n=8)	52.13 (n=8)
Low	67.63 (n=8)	50.50 (n=8)	48.25 (n=8)

Data from Delaney (1978)



5. Neither visualization/spatial ability nor elaboration conditions interact with materials differences in concreteness of verbal items.

Mean number of correct responses

		Response Imagery	
		High	Low
Visualization/ Spatial Ability	High (n=24)	31.54	26.29
	Low (n=24)	31.58	26.33

		Response Imagery	
		High	Low
Elaboration Condition	Visual (n=16)	34.94	29.75
	Verbal (n=16)	32.81	25.94

Data from Delaney (1978)

See also Stewart (1965, Expt. 3)

See also Miller, Levin & Pressley (1979) and Paivio & Yuille (1967)

6. The effectiveness of certain keyword conditions seems to depend on apparently minor population and/or treatment implementation differences. Compare, for example, the results of the following series of studies with those obtained by Hall, Wilson, & Patterson (1979).

Study 1.

Description: pacing of study trials controlled by experimenter; 5 anticipation PA trials, with 4 sec per frame, for each of two, 12-item Malay-English lists; visual presentation with subject pronouncing words

Results:

Instructional Condition	Mean Number Correct	
Keyword-generated, visual elaboration (n=16)	64.69	p=.003
Keyword-generated, verbal elaboration (n=16)	58.75	
Control (n=16)	50.19	

Data from Delaney (1978)

Study 2.

Description: subject-controlled allocation of study time; single-trial, study-test procedure with 4 minutes of study for 25 Russian-English pairs; visual presentation with no overt pronunciation

Results:

Instructional Condition	Mean Number Correct	
Keyword-generated, visual + verbal (n=22)	11.77	p=.015
Keyword-provided, visual + verbal (n=22)	7.82	

Data from Delaney & Starr (in preparation, Expt. 1)

Study 3.

Description: experimenter-paced; three-trial, study-test procedure, with 4 sec/item in both study and test phases of each trial; 36 Russian-English word pairs; simultaneous visual and oral (taped) presentation; subjects--students in undergraduate Spanish classes

Results:

Instructional Condition	Adjusted Mean Number Correct
Control (n=16)	63.71
Keyword-generated, visual elaboration (n=17)	70.74
Keyword-provided, visual elaboration (n=18)	54.80
Keyword-generated, verbal elaboration (n=16)	60.83
Keyword-provided, verbal elaboration (n=15)	60.29

Statistical Tests	Test Statistic
Overall between-groups effect	$F(4, 74) = 3.791$, $p = .007$
Keyword groups vs. control	$F(1, 74) = 0.367$, n.s.
Visual vs. verbal elaboration	$F(1, 74) = 0.520$, n.s.
Keyword-generated vs. keyword-provided	$F(1, 74) = 8.255$, $p = .005$
Elaboration cond. X keyword provision	$F(1, 74) = 6.123$, $p = .016$

Tests of regression of dependent variable on covariates

Covariate	Test Statistic
Paired-associate pretest	$F(1, 74) = 11.957$, $p = .001$
Visualization/spatial ability	$F(1, 74) = 0.281$, n.s.
Verbal fluency ability	$F(1, 74) = 9.590$, $p = .003$

Data from Delaney & Starr (in preparation, Expt. 2)

7. There is almost no systematic data on the question of whether keyword method effectiveness depends upon the particular foreign language being employed.

Possible Future Directions for Keyword Research

1. Development of an instrument that will allow prediction of performance in visual elaboration conditions not involving picture production.

2. Utilization of pre-measures of foreign language vocabulary learning to explore possible aptitude X treatment interactions and to reduce within-cell variability.

3. Investigation of the extent to which the abilities relevant to keyword task performance can themselves be modified.

4. Specification of the dimensions relevant to keyword method effectiveness along which foreign languages and foreign vocabulary items vary.

Appendix A
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